APPENDIX G

Standards

Background

G.1 One of the remarkable achievements of the global telephony system is that anyone with a telephone can call anyone else in the world with a telephone. This achievement comes about because of the interconnection of hundreds of autonomously operated telephone networks around the world. This global interconnection of telephone networks has only been made possible through technical standards that have been agreed internationally and committed to by almost all countries.

G.2 In the past, and largely for historical reasons, within countries there has tended to be a single telephone network operation, a monopoly usually owned by the government of that country. This operation was usually also empowered with administering telecommunications nationally. It would set technical national standards, represent the country at international standards forums and otherwise administer telecommunications internationally. This has tended to result in the development of international technical standards which have focused on:

- standards applying within a network (i.e., primarily to enable the interoperation of different equipment vendors)
- standards applying to customer premises equipment (i.e., to ensure the satisfactory operation of telecommunications end-to-end)
- standards applying to the international connection of national telephone networks

G.3 The interconnection of separately operated telephone networks within the same country has not, and continues not to be, addressed at international standards forums. This is mainly because such forums tend to be dominated by "traditional" administrators who have little interest in, or in some cases actively oppose, progressing such standards.

G.4 Telecommunications services and features available within a national telephony network tend to be much richer than the services and features available internationally between countries. International standards for the interconnection of national networks tend to be featureless, supporting little more than basic call set up and release.

G.5 Most telephone networks are capable of supporting many services over and above basic call connections. For example:

- call forwarding (call diversion)
- calling line (number) presentation

- freephone (0800) calling
- closed user groups (virtual private networking)
- centrex (central exchange service)
- Integrated Service Digital Network (ISDN)
- local number portability
- Personal Communication Services (PCS)

G.6 In general, for such services to interoperate seamlessly between networks (interoperation is a fundamental concept in a network of networks) there must be appropriate functionality and information flow to be supported within and over the interconnection between the networks.

G.7 A telecommunications network can be partitioned into different functional levels. These functional levels include:

- management (network and service management)
- databases (holding customer and service information)
- service logic (actual software for supporting services)
- switching (provides the basic capabilities for switching and transmission)

G.8 Basic call set up and release and some of the less complex services such as call forwarding and calling line (number) presentation require information flow at only the switching functional level. It is at this level where much of the international standards effort has concentrated, and hence these standards tend to be reasonably well developed, albeit usually with many options. However, the more complex services, such as virtual private networking and number portability, require information flows at all four functional levels. Standards at the management, database and service logic levels tend to be considerably less well developed, and hence many networks have implemented proprietary or at least partly proprietary solutions at these levels.

G.9 The support of the interoperation of services (particularly the more complex services) between networks results in a set of requirements which have not in general been addressed by standards. The standardisation of such requirements is not seen as being particularly necessary when such services are implemented within a single network, and hence have not been actively progressed. Requirements which tend to be unique to the interoperation of services between networks (i.e., network of networks) include:

- the seamless interoperation of services between networks
- mediation functions required to maintain each network's integrity

- the requirement to interconnect and interoperate networks at "higher" (i.e., management, database and service logic) functional levels, over and above the basic switching functional level

G.10 To consolidate the above, consider an example of the interoperation of a service between two networks, which is not presently possible in New Zealand today but would likely be of considerable benefit to customers. Consider a business which has wireline telephones (connected to a private branch exchange (PBX)) and which also has mobile phones. The PBX is connected to one network operator and the mobile telephones are connected to a different network operator. The business may have a desire to include the mobile telephones into the PBX extension numbering plan (that is, from the mobile phone, a four digit extension number is dialled to call a PBX wireline phone and the mobile phone can be called by dialling a four digit extension from the PBX wireline phone). For this service to operate between the two networks, there must be common management of the extension number databases in the two networks and information flow between the service logic functional levels in each network. Complete standards for achieving this are not presently available. However, a mixture of proprietary and existing standards could be developed to allow such interoperation to be realised in New Zealand relatively quickly.

Existing interconnection specifications

G.11 Telecom has by far the largest network in terms of the number of customers connected to it. New entrant network operators have little option but to directly interconnect with Telecom. Telecom only allows interconnection in accordance with its own specifications. Telecom has developed four specifications which cover interconnection of networks, these are:

- PTC 300 General requirements for network interconnection
- PTC 301 Telephone network interconnection by means of the R2MFC (multichannel frequency compelled) channel associated system
- PTC 331 Telephone network interconnection using Signalling System No. 7
- PTC 332 Local network interconnection (draft)

G.12 These specifications are based on the ITU-TS (International Telecommunications Union - Telecommunication Sector) recommendations. The Telecom set of interconnection specifications are entirely limited to the switching functional level and support basic call set up and release functionality. Until recently, no end-user services other than basic call set up and release functionality were supported in the specifications. A recent amendment by Telecom to the specifications now fully supports call forwarding. It is noteworthy that call forwarding has been fully defined in the ITU-TS recommendations since 1988 but only now included in the Telecom specifications.

Limitations with the existing situation

G.13 The limitations with the existing interconnection specification situation in New Zealand can be summarised as follows:

- the specifications are controlled by Telecom, with little opportunity for influence by the industry
- where additional functionality is desired, this must be negotiated with Telecom with no guarantee of success. Bilateral negotiation tends to be time consuming, inefficient, costly and likely to result in interconnection specification variations
- the Telecom specifications are not a national standard acknowledged by the industry. This lack of a recognised national standard has discouraged some telecommunication equipment vendors from offering equipment to the New Zealand market
- Telecom is reluctant to incorporate functionality on which the ITU-TS has yet to complete work, or to recognise any standard other than the ITU-TS recommendations. This stance is frustrating innovation
- when functionality is added to the Telecom specifications, its timeliness is inadequate (e.g., the seven-year delay in supporting call forwarding functionality at the interconnection)

G.14 Telecom controls the content of the interconnection specifications. It makes amendments to the specifications from time to time. Although seeking industry comments, experience has demonstrated that Telecom rarely acts upon the comments received. Amendments to the specifications may:

- clarify the existing description
- update the content in line with recent developments in the ITU-TS recommendations
- add functionality
- remove functionality

G.15 The most recent amendment was contained in Telecom Access Standards Newsletter No. 81, May/June 1994. In this amendment, Telecom removed functionality termed "Information Request" functionality from the specification, ignoring objections by the industry.

G.16 As part of the same set of amendments, Telecom reduced the maximum message occupancy of signalling links from 20% (the ITU-TS recommendation) to 10% because of technical limitations within Telecom's network. This amendment will put BellSouth and the industry to significant expense because twice as many signalling links must be

provisioned at the interconnection with Telecom than would be the case if the ITU-TS recommendations were followed. This amendment applied immediately and without any commitment by Telecom to eventually return to the ITU-TS signalling link occupancy recommendations. This is an example of how Telecom deviates from international standards when it is of advantage to it to do so.

G.17 Where additional functionality to that contained in the Telecom specifications is desired, this must be negotiated directly with Telecom. There are no guarantees of success and the actual implementation of the functionality is likely to be costly to the network operator requesting the functionality.

G.18 An example is BellSouth's request to Telecom to support functionality to allow access to the international signalling system No. 7 network to enable BellSouth to offer GSM automatic international roaming service to its customers. This service is an important differentiator to the services offered by the Telecom mobile network. The requirement to negotiate this functionality was included in the original interconnection agreement between Telecom and BellSouth, with detailed negotiation to be separate from the interconnect negotiations. Even then, the negotiation of a suitable technical solution (with acceptable commercial terms) took almost two years and required a joint briefing chaired by the Ministry of Commerce.

G.19 Another example of additional functionality which BellSouth attempted to negotiate with Telecom but eventually abandoned was the support of an international length A-number (15 digits). International length A-number is part of the ITU-TS recommendations that Telecom does not support at the interconnection. The A-number is the telephone number of the calling party and is passed from the BellSouth network to the Telecom network to enable BellSouth customers to have access to Telecom services such as operator services. However, Telecom's network does not support international length A-numbers which is necessary in the case of GSM roamers from other countries. Because of this lack of functionality, BellSouth has gone to considerable expense to modify its network to allow roamers from countries onto BellSouth's network. As a consequence, roamers to the BellSouth network cannot access some services, such as the Telecom operator services.

G.20 Telecom has demonstrated that it is unwilling to negotiate functionality which is not covered by ITU-TS recommendations. This means that support of the interoperability of the more complex services between networks which require interconnection at the higher functional levels is unlikely to proceed in the near term. This will significantly reduce innovation in telecommunication services to the general public in New Zealand.

APPENDIX H

Numbering

Description

H.1 Numbers are a fundamental requirement for the operation of a telecommunications network. They are used to provide information to both networks and their customers about how to connect a call. Numbers can have embedded within them a variety of information. This can include geographic location, service provider or network operator information, tariffing information, types of service provided, etc.

Importance of numbering to competition

H.2 When customers subscribe to a network operator or service provider, they are generally assigned a number or set of numbers. For many customers, especially business customers, these numbers become an integral part of their identity and are considered either a tangible or intangible asset.

H.3 Therefore, the ability of customers to maintain the use of the same number over a long period of time is of paramount importance. This means that the inability that currently exists for customers to retain the same telephone number if they choose to switch service providers or telecommunications networks is a significant barrier to their decision to change.

H.4 In addition to this, competition can be restricted where a natural monopoly chooses to promote services based on number ranges or patterns that cannot be matched by those networks attempting to compete. For example, Telecom promotes services on its mobile network which are accessed by numbers beginning with *. This is being done in the full knowledge that these services cannot be supported by the BellSouth GSM network, thus creating a barrier to competition because customers may choose not to join a network that they perceive provides "limited" service. This can also serve to confuse customers and can create potentially dangerous situations in the case of services like *555 (Traffic Safety Service).

Current New Zealand environment with respect to numbering

H.5 Historically, the management and control of the New Zealand national numbering plan has been in the hands of Telecom. While there was no competition in the telecommunications market, there was no conflict between Telecom's role as a number administrator and its role as a supplier of telecommunications services. This is no longer the case. There are now many obvious examples where the conflict that has now emerged is limiting the ability for new entrants into the New Zealand telecommunications market to compete with the dominant incumbent.

H.6 In order to try and make progress on this important competitive issue, the New Zealand Telecommunications Numbering Advisory Group has been convened and is chaired by the Ministry of Commerce. This group has representation from all the telecommunications network operators and is expected to operate by consensus to

develop a numbering environment that allows fair competition and also, importantly, to meet the current and future needs of customers.

H.7 Unfortunately, the competitive environment in New Zealand today means that this approach has not worked so far and, indeed, is unlikely to work in the future. Thus, the market dominance of the dominant incumbent is the more easily perpetuated.

Conclusions

H.8 In order for there to be full competition in the telecommunications market, management and control of the New Zealand national numbering plan must not remain in the hands of one of the competitors, particularly if that competitor already has a dominant position in the market. Instead, it should be administered and controlled by an organisation representing the interests of the telecommunications industry, and of all concerns, as a whole.

H.9 Furthermore, full portability of numbers between networks must be seen as a precursor to effective competition. Since the implementation of number portability relies on the active co-operation by the dominant incumbent, priority needs to be given to ensuring that an environment exists where that co-operation can be assured.

APPENDIX I

Bibliography

Adams, Walter, and James Brock, (1982), "Integrated Monopoly and Market Power: System Selling, Compatibility Standards and Market Control", *Quarterly Review of Economics and Business*, vol. 22, pp. 29-42.

Albon, (1994) "Interconnection Pricing: An Analysis of the Efficient Component Pricing Rule," 18 *Telecommunications Policy*, 414.

Alleman, James H., "Review of Competition in Local Telephony", by Baumol, William J. and J. Gregory Sidak, *Information Economic and Policy*, (forthcoming).

Alleman, James, "Interconnection and Incentive Regulation: An Overview", International Telecommunications Society Workshop, Wellington, New Zealand, 10-12 April 1995.

Anderson, P. and Tushman, M., (1990), A Technological Discontinuities and Dominant Design; "A Cyclical Model of Technological Change", *Administrative Science Quarterly*, vol. 35, pp.604-633.

Armstrong, Mark, (1992), "Optimal Nonlinear Pricing by a Multiproduct Monopolist," D. Phil., Oxford University.

Armstrong, Mark and Chris Doyle, "Access Pricing, Entry and the Baumol-Willig Rule", Discussion Paper No. 9422, Department of Economics, University of Southampton, 1994

Armstrong, Mark and Chris Doyle, (1993), "Network Access Pricing", mimeo.

Armstrong, Mark and Chris Doyle, (1994), "Interconnection and the Effects of Entry", mimeo.

Armstrong, Mark and Chris Doyle, (1994), "Access Pricing in a Regulated Industry", mimeo.

Armstrong, Mark and Chris Doyle, (1995), "The Economics of Access Pricing", mimeo.

Armstrong, Mark and John Vickers, "The Access Pricing Problem", International Telecommunications Society Workshop, Wellington, New Zealand, 10-12 April 1995 (mimeo dated March 1995).

AUSTEL, (1995), "An Interconnection Model for the Multiservice Deliverer Environment", mimeo presentation.

AUSTEL, (1995), "Appropriate Interconnection and Access Arrangements - A Regulator's View", mimeo.

Baseman, Kenneth C., Frederick R. Warren-Boulton, and Glenn Woroch, (1994), "Microsoft Plays Hardball: Use of Exclusionary Pricing and Technical Incompatibility to Maintain Monopoly Power in the Market for Operating System Software", mimeo.

Baumol, William J., (1994) "New York State Teleco Testimony", mimeo.

Baumol, William J., Elizabeth Bailey, and Robert Willig, (1984), "The Weak-Invisible Hand Theorem", *American Economic Review*.

Baumol, William J., "Some Subtle Issues in Railroad Regulation", *International Journal of Transportation Economics*, vol. 10, pp 341-355.

Baumol, William J. and J. Gregory Sidak, "The Pricing of Inputs Sold to Competitors", *Yale Journal on Regulation*, vol. 11, no. 1, Winter 1994.

Baumol, William J., and J. Gregory Sidak, (1994), *Toward Competition in Local Telephony*, The MIT Press & The American Enterprise Institute, Washington DC.

Berg, Sanford V., (1984), "Standardization Issues in Telecommunications: Competition, Cooperation or Coercion?", mimeo.

Berg, Sanford V., (1985), "Technological Externalities and a Theory of Technical Compatibility Standards", mimeo.

Berg, Sanford V., (1987), "Public Policy and Corporate Strategies in the AM Stereo Market", in *Product Standardization as a Tool of Competitive Strategy*, Landis Gabel ed., North Holland.

Berg, Sanford V., (1987), "Technical Standards as Public Goods: Demand Incentives for Cooperative Behavior", mimeo.

Berg, Sanford V., (1988), "Duopoly Compatibility Standards with Partial Cooperation and Standards Leadership", *Information Economics and Policy*, vol., pp. 35-53.

Berg, Sanford V., (1989), "The Production of Compatibility: Technical Standard as Collective Goods", Kyklos, vol. 42, pp. 361-383.

Berg, Sanford V., (1993), "A Duopoly Model of Technological Externalities: Standards and Compatibility", mimeo.

Besen, Stanley M., (1990), "European Telecommunications Standards Setting: A Preliminary Analysis of the European Telecommunications Standards Institute", mimeo.

Besen, Stanley M. and Joseph Farrell, (1993), "Competition Within and Between Bandwagons: Strategies and Tactics in Standardization", forthcoming, *Journal of Economic Perspectives*.

Besen, Stanley M. and Leland Johnson, (1986), "Compatibility Standards, Competition, and Innovation in the Broadcasting Industry", Rand Corporation, R-3453-NSF.

Besen, Stanley M., and Garth Saloner, (1989), "Compatibility Standards and The Market for Telecommunications Services", in Robert Crandall and Kenneth Flamm (eds.) *Changing Rules: Technological Change, International Competition, and Regulation in Telecommunications*, Washington: The Brookings Institution, pp. 177-220.

Besen, S. and Saloner, G., (1989), "The Economics of Telecommunications Standards", in Crandall, R. and Flamm, K (eds.), *Changing the Rules: Technological Change, International Competition and Regulation in Telecommunications*, Washington: The Brooking Institution, pp. 177-220.

Blank, Larry R., David L. Kaserman, and John W. Mayo, (1995), "Dominant Firm Pricing with Competitive Entry and Regulation: The Case of Interlata Toll", mimeo.

Braunstein, Yale, and White, Lawrence, (1985), "Setting Technical Compatibility Standards: An Economic Analysis", *The Antitrust Bulletin*, vol. 30, pp. 337-355.

Brock, Gerald W., (1981), *The Telecommunications Industry: The Dynamics of Market Structure*, Cambridge, MA: Harvard University Press.

Brock, Gerald W., (1975), "Competition, Standards, and Self-Regulation in the Computer Industry", in *Regulating the Product*, Richard Caves and Mark Roberts, Creditors, Ballinger.

Brown, Stephen J. and David S. Sibley, (1986) *The Theory of Public Utility Pricing*, Cambridge University Press, Cambridge, New York and Melbourne.

Burnell, Stephen, Evans, Lewis and Yao, Shuntian, "Pricing Interconnection," International Telecommunications Society Workshop, Wellington, New Zealand, 10-12 April 1995.

Burton, Mark L., and Wesley W. Wilson, (1995), "Network Pricing and Vertical Foreclosure in Railroad Markets", *mimeo*.

Cabral, Luis, (1990), "On the Adoption of Innovations with 'Network' Externalities", *Mathematical Social Sciences*, vol. 19, pp. 229-308.

Cabral, Luis, David Salant, and Glenn Woroch (1994), "Monopoly Pricing with Network Externalties", mimeo.

Calhoun, George C., (1992), *Wireless Access and the Local Telephone Network*, Artech House, Inc.

Cargill, C., (1989), *Information Technology Standardization: Theory, Process and Organizations*, Digital Press.

Cave, Martin and Peter Crowther, (1995), "Competition Law Approaches to Regulating Access to Utilities: The Essential Facilities Doctrine," mimeo.

Comanor, William S., (1985), "Vertical Price-Fixing, Vertical Market Restrictions, and the New Antitrust Policy", *Harvard Law Review*, vol. 98, pp. 983-1002.

Comanor, William S. and Lawrence White, (1990), "Market Power or Efficiency: A Review of Antitrust Standards", mimeo.

Crew, Michael, (1995), "Efficient Component Pricing (ECP) and Alternative Approaches to the Pricing of Access to Competitors," mimeo.

Cronin, "An Outline of the Australian Scene", International Telecommunications Society Workshop, Wellington, New Zealand, 10-12 April 1995.

Crook, John, "Competition and Interconnection: Successes and Challengers (A Practical Perspective)", International Telecommunications Society Workshop, Wellington, New Zealand, 10-12 April 1995.

David, Paul A., (1986), "Technology Diffusion, Public Policy, and Industrial Competitiveness", in *The Positive Sum Strategy: Harnessing Technology for Economic Growth*, National Academy of Sciences.

David, Paul A., (1987), "Some New Standards for the Economics of Standardization in the Information Age", in P. Dasgupta and P. Stoneman (eds.) *Economic Policy and Technological Performance*, Cambridge: Cambridge University Press.

David, Paul A., (1987), "The Battle of the Systems and the Evolutionary Dynamics of Network Technology Rivals", mimeo.

David, Paul A., (1991), "Narrow Windows, Blind Giants and Angry Orphans: The Dynamics of System Rivalries and Dilemmas of Technology Policy", in Arcangel, F., et al. (eds.), *Innovation Diffusion*, vol. 3, New York: Oxford University Press.

David, Paul A., and Shane Greenstein, (1991), "The Economics of Compatibility Standards: An Introduction to Recent Research", *Economics of Innovation and New Technology*, vol. 1, no. 1.

David, Paul A., and Hunter K. Monroe, (1994), "Standards Development Strategies Under Incomplete Information - Isn't the 'Battle of the Sexes' Really a Revelation Game?", mimeo.

David, Paul A., and W. Edward Steinmueller (1994), "Economics of Compatibility Standards and Competition in Telecommunication Networks", *Information Economics and Policy*, vol. 6, pp. 217-241.

Davies, Michael, and Marcia Poletti, (1995), "Innovation, Interconnection and Information Infrastructure," International Telecommunications Society Workshop, Wellington, New Zealand, 10-12 April 1995.

Deane, Roderick, "A review of New Zealand's Telecommunication Reforms and Future Outlook", International Telecommunications Society Workshop, Wellington, New Zealand, 10-12 April 1995.

Ebril, Liam P. and Steven M. Slutsky, (1990), "Production Efficiency and Optimal Pricing in Intermediate Good Regulated Industries", *International Journal of Industrial Organization*, vol. 8, pp. 417-442.

Economides, Nicholas, (1989), "Desirability of Compatibility in the Absence of Network Externalities", *American Economic Review*, vol. 79, no.5, pp. 1165-1181.

Economides, Nicholas, (1991), "Compatibility and the Creation of Shared Networks," presented at the Annenberg Conference on Electronic Services Networks, February 23, 1990, Washington DC, in *Electronic Services Networks: A Business and Public Policy Challenge*, edited by Margaret Guerin-Calvert and Steven Wildman, Praeger Publishing Inc., New York: 1991.

Economides, Nicholas (1993), "Mixed Bundling in Duopoly", Discussion Paper EC-93-29, Stern School of Business, N.Y.U.

Economides, Nicholas, (1993), "A Monopolist's Incentive to Invite Competitors to Enter in Telecommunications Services", in Gerard Pogorel (ed.), *Global Telecommunications Services and Technological Changes*, Elsevier, Amsterdam: 1993.

Economides, Nicholas (1994), "The Incentive for Vertical Integration", Discussion Paper EC-94-5, Stern School of Business, N.Y.U.

Economides, Nicholas, (1996), "Network Externalties, Complementarities, and Invitations to Enter", forthcoming in the *European Journal of Political Economy*.

Economides, Nicholas (1996), "The Economics of Networks", plenary address, EARIE conference, September 1994, Discussion Paper no. EC-94-24, Stern School of Business, N.Y.U., forthcoming in the *International Journal of Industrial Organization*.

Economides, Nicholas and Fredrick Flyer, (1995), "Technical Standards Coalitions for Network Goods", Discussion Paper no. EC-95-12, Stern School of Business, N.Y.U.

Economides, Nicholas and Charles Himmelberg, (1995), "Critical Mass and Network Size with Application to the US Fax Market", Discussion Paper no. EC-95-11, Stern School of Business, N.Y.U.

Economides, Nicholas and Steven C. Salop, (1992), "Competition and Integration among Complements, and Network Market Structure", *Journal of Industrial Economics*, vol. 40, no.1, pp 105-123.

Economides, Nicholas and Lawrence J. White, (1994), "Networks and Compatibility Implications for Antitrust", *European Economic Review*, vol. 38 pp. 651-662.

Economides, Nicholas and Lawrence J White, (1995), "Interconnection and Access Pricing: How Efficient is the Efficient Components Pricing Rule?", Discussion Paper no. EC-95-04, Stern School of Business, N.Y.U., forthcoming *Antitrust Bulletin*.

Economides, Nicholas and Glenn Woroch (1992), "Benefits and Pitfalls of Network Interconnection", Discussion Paper no. EC-92-31, Stern School of Business, N.Y.U.

Ergas, Henry, (1995a), "Access and Interconnection in Public Utilities", mimeo.

Ergas, Henry, (1995b), "Managing Interconnection: Issues of Institutional Design", mimeo, presented at International Telecommunications Society Workshop, Wellington, New Zealand, 10-12 April 1995.

Ergas, Henry and Eric Ralph, "Pricing Network Interconnection: Is the Baumol-Willing Rule the Answer?" (memo.) Trade Practices Commission 24 February 1994.

Ergas, Henry and Eric Ralph, "The Interconnection Problem with a focus on Telecommunications", (memo.) undated., Symposium, Boulder, January, 1995.

Einhorn, Michael, "Universal Service: Realities and Reform", Paper presented to the Telecommunications Infrastructure and the Information Economy Conference, University of Michigan, 10-11 March 1995.

Farrell, Joseph, (1989), "Standardization and Intellectual Property", mimeo.

Farrell, Joseph, (1993), "Choosing the Rules for Formal Standardization", mimeo.

Farrell, Joseph, Hunter K. Monroe, and Garth Saloner, (1993), "Order Statistics, Interface Standards, and Open Systems," mimeo.

Farrell, Joseph and Saloner, Garth (1985), "Standardization, Compatibility, and Innovation", *Rand Journal of Economics*, vol. 16, pp. 70-83.

Farrell, Joseph and Saloner, Garth, (1986), "Standardization and Variety", *Economics Letters*, vol. 20, pp. 71-74.

Farrell, Joseph and Saloner, Garth, (1986), "Economic Issues in Standardization", in J. Miller (ed.) *Telecommunications and Equity*, Amsterdam: North Holland.

Farrell, Joseph and Saloner, Garth, (1987), "Competition, Compatibility and Standards: The Economics of Horses, Penguins, and Lemmings", in *Product Standardization and Competitive Strategy*, Landis Gabel, ed., North Holland.

Farrell, Joseph and Saloner, G., (1988), "Coordination Through Committees and Markets", *Rand Journal of Economics*, vol. 19, pp. 235-252.

Fishman, Arthur and Neil Gandal, (1994), "Standardization and the Rate of Technological Progress".

Gabel, David, "Pricing voice telephony services: who is subsidising whom" *Telecommunications Policy* , vol. 19, no. 6, August 1995.

Gabel, David, and David F. Weiman, (1994), "Historical Perspectives on Interconnection between Competing Local Operating Companies: The United States, 1894-1914", International Telecommunications Society Workshop, Wellington, New Zealand, 10-12 April 1995.

Gabel, H. Landis, (1987), "Open Standards in the European Computer Industry: The Case of X/OPEN", in H. L. Gabel (ed.), *Product Standardization and Competitive Strategy*, pp. 91-123, Amsterdam: Elsevier.

Gabel, H. Landis, (1991), *Competitive Strategies for Product Standards*, London: McGraw Hill.

Gaimon, Cheryl; Ho, Johnny C, "Uncertainty and the acquisition of capacity: A competitive analysis", *Computers & Operations Research*, vol. 21, iss. 10, December 1994, pp. 1073-1088.

Galt, D. (1995), "Telecommunications Regulatory Structures in New Zealand", mimeo, presented at International Telecommunications Society Workshop, Wellington, New Zealand, 10-12 April 1995.

Gasmi, Farid and William W. Sharkey, "Toward the Endogenization of Firm's Cost in Empirical Studies of Technology", International Telecommunications Society Workshop, Wellington, New Zealand, 10-12 April 1995.

Greenstein, Shane M., (1992), "Invisible Hands Versus Invisible Advisors: Coordination Mechanisms in Economic Networks", mimeo.

Greenstein, Shane M., (1989), "Select Bibliography on the Economics of Compatibility Standards and Standardization", mimeo.

Greenstein, Shane M., (1992), "Invisible Hands Versus Invisible Advisors: Coordination Mechanisms in Economic Networks", mimeo.

Grieve, Willie and Levin, Stanford I., "Economic Principles and Pricing Rules of Local Network Interconnection and Network Competent Unbundling with Applications for New Zealand", International Telecommunications Society Workshop, Wellington, New Zealand, 10-12 April 1995.

Grindley, Peter C., (1995), "Innovation and Interconnection: The Case of Telepoint in the UK", International Telecommunications Society Workshop, Wellington, New Zealand, 10-12 April 1995.

Grindley, Peter C., (1995), *Standards, Strategy and Policy: Cases and Stories*, Oxford: Oxford University Press, 285 pp.

Halttunen, Matti, "Telecom Finland, From Trunk Monopoly to Challenger", International Telecommunications Society Workshop, Wellington, New Zealand, 10-12 April 1995.

Harris, Robert, Gregory L. Rosston, and David J. Teece, "Competition and Unbundling in Local Telecommunications: Implications for Antitrust Policy", Paper presented at the Telecommunications Policy Research Conference, October, 1994.

Hergert, Michael, (1987), "Technical Standards and Competition in the Microcomputer Industry", in *Product Standardization and Competitive Strategy*, H. Landis Gabel (ed.) North-Holland, pp. 67-89.

Jamison, Mark, "A Competitive Framework for Pricing Interconnection in Telecommunications", *Denver Journal of International Law and Policy* (forthcoming).

Kahn, Alfred E. and William E. Taylor, "The Pricing of Inputs Sold to Competitors: A Comment", *Yale Journal on Regulation*, vol. 11, no. 1, Winter 1994.

Kaserman, David L. and John W. Mayo, "Cross-Subsides in Telecommunications: Roadblocks on the Road to More Intelligent Telephone Pricing", *Yale Journal on Regulation*, vol. 11, no. 1, Winter 1994.

Kelley, Chris L., "The Contestability of the Local Network: The FCC's Open Network Architecture Policy", *Federal Communications Law Journal*, Vol. 45, No. 1., p. 89.

Kende, Michael, (1991), "Strategic Standardization in Trade with Network Externalities", mimeo.

Krattenmaker, Thomas, and Salop, Steven, C., (1986), "Anti-competitive Exclusion: Raising Rival's Costs to Achieve Power over Price", *Yale Law Journal*, vol. 96, pp. 209-293.

Laffont, Jean-Jacques and Jean Tirole, (1990), "The Regulation and Multi-product Firms", *Journal of Public Economics*, vol. 43, pp 1-66.

Laffont, Jean-Jacques and Jean Tirole, "Access Pricing and Competition", *European Economic Review*, vol. 38, 1994, pp. 1673-1710.

Laffont, Jean-Jacques and Jean Tirole, *A Theory of Incentives in Procurement and Regulation*, Cambridge, Mass, MIT Press, 1993.

Laffont, Jean-Jacques and Jean Tirole, "Using Cost Observation to Regulate Firms", *Journal of Political Economy*, vol. 94, pp. 614-641.

Laffont, Jean-Jacques and Tirole, Jean, "Creating Competition Through Interconnection", International Telecommunications Society Workshop, Wellington, New Zealand, 10-12 April 1995.

Larson, Alexander C., (1995), "Interconnection and Access Pricing: An Alternative Derivation of the Efficient Components Pricing Rule", mimeo.

Larson, Alexander C. and Steve G. Parsons, (1993), "Telecommunications Regulation, Imputation Policies and Competition", *Hastings Communications and Entertainment Law Journal*, vol. 16, no. 1, pp. 1-50.

Larson, Alexander C. and Steve G. Parsons, (1994), "An Economic Analysis of Transfer Pricing and Imputation Policies for Public Utilities", in *Incentive Regulation for Public Utilities*, M. A. Crew (ed.). Boston: Kluwer Academic Publishers, pp. 65-82.

Larson, Alexander C. and Margerete Z. Starkey, (1994), "Unbundling Issues and US Telecommunications Policy", *Stanford Law and Policy Review*, vol. 6, pp. 83-98.

Lehr, William, (1992), "Compatibility Standards and Industry Competition: Two Case Studies", mimeo.

Lehr, William, (1991), "The Case of Two Data Transport Standards: IEEE's 802.6 Metropolitan Area Network (MAN) versus the ANSI X3's Fiber Distributed Data Interface (FDDI)", mimeo.

Lehr, William, (1992), "Network Quality Choices in a Network of Networks", mimeo.

Levin, Stanford I., "Local Exchange Competition, Unbundling and Interconnection Policy", (mimeo), Paper presented at the Telecommunications Infrastructure and the Information Economy Conference, University of Michigan, 10-11 March 1995.

Liebowitz and Stephen E. Margolis, "Market Processes and the Selection of Standards", mimeo.

Lipman, Andrew, "The Requirements for Competition: Interconnection around the World", International Telecommunications Society Workshop, Wellington, New Zealand, 10-12 April 1995.

Lipman, Andrew, "The Unnatural Monopoly", International Telecommunications Society Workshop, Wellington, New Zealand, 10-12 April 1995.

Marcus, Michael J., and Thomas Spavins, (1993), "The Impact of Technical Change on the Structure of the Local Exchange and the Pricing of Exchange Access: An Interim Assessment", mimeo.

Masmoudi, Hatem, and Francois Prothais, (1994), "Access Charges: An Example of Application of the Fully Efficient Rule Modelling Access to a Fixed Network", mimeo.

Matutes, Carmen, and Regibeau, Pierre, (1989), "Standardization Across Markets and Entry", *Journal of Industrial Economics*, vol. 37, pp. 359-371.

Matutes, Carmen, and Regibeau, Pierre, (1992), "Compatibility and Bundling of Complementary Goods in a Duopoly", *Journal of Industrial Economics*, vol. 40, no.1, pp. 37-54.

Matutes, Carmen, and Regibeau, Pierre, (1994), "A Selective Review of the Economics of Standardization: Entry Deterrence, Technological Progress and International Competition", mimeo.

Matutes, Carmen, and Regibeau, Pierre, (1989), "Standardization Across Markets and Entry", *Journal of Industrial Economics*, vol. 37, pp. 359-371.

McCormick, Geoff, "Efficient Component Pricing (Baumol-Willig)", Paper presented at the Telecommunications Infrastructure and the Information Economy Conference, University of Michigan, 10-11 March 1995.

McCormick, Geoff, "Regulation and Pricing of Local Interconnection in New Zealand - Lessons for America", Paper presented at the Twenty-Third Annual Telecommunications Policy Research Conference, Solomon Is, MD, 30 September-2 October 1995.

McFarland, Henry, (1985), "Railroad Competitive Access: An Economic Analysis", mimeo.

Ministry of Commerce and The Treasury, New Zealand, "Regulation of Access to Vertically-Integrated Natural Monopolies: A Discussion Paper", Wellington, New Zealand, August 1995.

Mitchell, Bridger M., Werner Neu, Karl-Heinz Neumann, and Ingo Vogelsang, (1993), "The Regulation of Pricing of Interconnection Services", mimeo.

Mitchell, Bridger M. & Ingo Vogelsang, *Telecommunications Pricing: Theory and Practice*, Cambridge University Press, Cambridge, England, 1991.

Monroe, Hunter, (1987), "The Economics of Compatibility Standards", mimeo.

Mueller, Milton, "On the Frontier of Deregulation: New Zealand Telecommunications and the Problem of Interconnecting Competing Networks", Reason Foundation Policy Study No. 177 (May 1994).

Nakano, Kageo, "Liberalisation and Competition in Japan", International Telecommunications Society Workshop, Wellington, New Zealand, 10-12 April 1995.

Neu, Werner, (1994), "Study on Network Interconnection in the Domain of ONP", mimeo.

Neu, Werner, (1995), "A Case Against Access Charges", mimeo.

Neu, Werner, and Karl-Heinz Neumann (1993), "Interconnection Agreements in Telecommunications", mimeo.

Noam, Eli, (1994), *Interconnecting the Network of Networks*, AEI Studies in Telecommunications Deregulation.

Noam, Eli M., "Beyond Liberalization III: Reforming Universal Service", Telecommunications Policy, Vol. 18, No. 9, XXX 1994, 678-704.

"NYNEX, MFS Announce Agreement for New York Interconnection", *Telco Competition Report*, February 2, 1995, Vol. 4, No. 3, 1-3.

"NYNEX, Teleport have reciprocal Compensation Agreement: Teleport Builds Phoenix Network with Cable Partnership", *Telco Competition Report*, 7 July, 1994, Vol., No. 14, 4-6.

OECD (1995), *Mobile Communication: Pricing Strategies and Competition*, Paris: OECD.

Palmer, Karen, "A Test for Cross Subsidy in Local Telephone Rates: Do Business Customers Subsidize Residential Customers?", *Rand Journal of Economics*, vol. 2, no. 3, Autumn 1992.

Panzer & Wildman, "Network Competition and the Provision of Universal Service", forthcoming in *Journal of Industrial and Corporate Change*.

Parson, Steve G. "Seven Years after Kahn and Shew: Lingering Myths on Costs and Pricing Telephone Service", *Yale Journal on Regulation*, vol. 11, no. 1, Winter 1994.

Pattas, Chris (1995), "Appropriate Interconnection and Access Arrangements - A Regulator's View", mimeo.

Patterson, Ross, Brian Savin, and Michael Davies, (1995), "Light-Handed Regulation of Telecommunications in New Zealand", mimeo.

Postrel, S.R., (1990), "Competing Networks and Proprietary Standards: the Case of Quadraphonic Sound", *Journal of Industrial Economics*, vol. 19, pp. 221-34.

Privy Council, Judgment of the Lords of the Judicial Committee for the Privy Council, 19 October 1994.

Ralph, Eric, "An Implementable Interconnection Mechanism", International Telecommunications Society Workshop, Wellington, New Zealand, 10-12 April, 1995.

Ralph, Eric, (1995), "Regulating an Input Monopolist: A Low Information Interconnection Mechanism", mimeo.

Ralph, Eric, and Henry Ergas, "The Interconnection Problem with a Focus on Telecommunications", Presentation given at the Strategic Alliance and Interconnection Symposium, University of Colorado at Boulder, 8-10 January 1995.

Rosenberg N., (1994), *Exploring the Black Box, Technology, Economics, and History*, Cambridge: Cambridge University Press.

Rosston, G. and Teece, D. (1993), "Competition and "Local" Communications: Innovation, Entry and Integration", *Journal of Industrial and Corporate Change*, (forthcoming).

Salop, Steven C. and David Scheffman, (1983), "Raising Rival's Costs", *American Economic Review*, vol. 73, pp. 267-271.

Salop, Steven C. and David Scheffman, (1984), "Multi-Market Strategies in a Dominant Firm Industry", mimeo.

Salop, Steven C., Scheffman, D., and Schwartz, W., (1984), "A Bidding Analysis of Special Interest Regulation: Raising Rivals' Costs in a Rent-Seeking Society", in *The Political Economy of Regulation: Private Interests in the Regulatory Process*, pp. 102-127, Washington DC: Federal Trade Commission.

Schumpeter, J. (1943), *Capitalism, Socialism and Democracy*, 2nd ed, London: George Allen and Unwin.

Sharkey, William, and Martin Perry (1992), "Economic Analysis of Standardization as Applied to Telecommunications", mimeo.

Shurmer, Mark and Gary Lea, (1994), "Telecommunications Standardization and Intellectual Property Rights: A Fundamental Dilemma?", mimeo.

Sirbu, Marvin, and K. Hughes, (1986), "Standardization of Local Area Networks", mimeo.

Sirbu, Marvin, and Steven Stewart, (1986), "Market Structure and the Emergence of Standards: A Test in the Modem Market", mimeo.

Sirbu, Marvin, and M. Weiss, (1989), "Technology Choice in Voluntary Standards Committees: An Empirical Analysis", mimeo.

Skayannis, Pantelis and Dimitris Yannelis, (1995), "Network Connection and Access Pricing in Practice: The Case of the Greek Telecommunications Organisation", mimeo.

Taylor, William E., "The Pricing of Inputs Sold to Competitors: A Comment", *Yale Journal on Regulation*, vol. 11, no. 1, Winter 1994.

Teece, David, (1988), "Technological Change and the Nature of the Firm", in Dosi, G., et al (eds.), *Technological Change and Economic Theory*, London: Pinter, pp. 256-281.

Teece, David, (1994), "Telecommunications in Transition: Unbundling, Reintegration, and Competition", *Michigan Telecommunications and Technology Law Review*, (forthcoming).

Teece, David, "Unbundling, Local Competition and the Ameritech Waivers", Paper presented at the Telecommunications Infrastructure and the Information Economy Conference, University of Michigan, 10-11 March 1995.

Train, Kenneth E., *Optimal Regulation: The Economic Theory of Regulation*, MIT Press, 1991.

Tye, William B., (1990), *The Theory of Contestable Markets: Applications to Regulatory and Antitrust Problems in the Rail Industry*, Greenwood Press.

Tye, William B., (1990), "The Economics of Pricing Network Interconnection: Theory and Application to the Market for Telecommunications in New Zealand", mimeo.

Tye, William B., (1993), "Pricing Market Access for Regulated Firms", *Logistic and Transportation Review*, vol. 29, pp. 39-67.

Tye, William B., "Response: The Pricing of Inputs Sold to Competitors", *Yale Journal on Regulation*, vol. 11, no. 1, Winter 1994.

Tye, William B., "The Pricing of Inputs Sold to Competitors: A Response", *Yale Journal of Regulation*, vol. 11, pp. 203-240, 1994.

Tye, William B. and Carlos Lapuerta, (1995), "Is The Tye and Lapuerta Analysis Based on a Misunderstanding of the Parity Principle?", mimeo.

Vietor, Richard and Dekkers Davidson, (1985), "The Economics and Politics of Deregulation: The Issue of Telephone Access Charges", *Journal of Policy Analysis and Management*, vol. 5, no. 1, pp. 3-22.

Walker, Dawson and Jonathan Solomon, "The Interconnection Imperative: 'E pluribus Unum'", Telecommunications Policy, May/June, 17(5), 1993, 257-280.

Wang, Hong-Mei, "The Network Interconnection Charges During Telecommunications Development", International Telecommunications Society Workshop, Wellington, New Zealand, 10-12 April 1995.

Werden, Gregory, (1988), "The Law and Economics of the Essential Facilities Doctrine", *St. Louis University Law Review*, vol. 32, pp. 432-80.

Wissenschaftliches Institute fur Kommunikations dienste and the European-American Center for Policy Analysis, Study for the European Commission: Network Interconnection in the Domain of ONP, Study of DG XIII of the European Commission, November 1994.

Willig, Robert, "The Theory of Network Access Pricing", in Harry M. Trebing, ed. *Issues in Public Utility Regulation*, Michigan State University Public Utility Papers, 1979.

Wolak, Frank A., (1994), "Can Universal Access Survive in a Competitive Telecommunications Environment?", Evidence from the Consumer Expenditure Survey, mimeo.

Woroch, Glenn, (1991), "Bargaining Over Network Interconnection", forthcoming in *Private Networks and Public Objectives*, Eli Noam (editor).

van Cuilenburg, Jan; Slaa, Paul, "Competition in the local loop", Telecommunications Policy [TCP] ISSN: 0308-5961, vol. 18, iss. 1, Jan/Feb 1994, pp: 51-65.

Zielinski, Paul, "The Rochester Telephone Telephone Competitive Market Plan", International Telecommunications Society Workshop, Wellington, New Zealand, 10-12 April 1995.

APPENDIX J

Contributors to BellSouth's Submissions

Professor Nicholas Economides; Stern School of Business, New York University

Alain de Fontenay; de Fontenay, Savin & Kiss

Eric de Fontenay; de Fontenay, Savin & Kiss

Professor David Gabel; City University of New York

Peter Grindley; Law & Economics Consulting Group, Inc.

Michael O'Bryan; Minter Ellison

Michael Pryles; Minter Ellison

Eric Ralph; George Washington University

Brian Savin; de Fontenay, Savin & Kiss

Professor David Teece; University of California at Berkeley, Law & Economics Consulting Group, Inc.

Professor Jean Tirole; Institut d' Economie Industrielle, Université des Sciences Sociales de Toulouse

Professor Glenn Woroch; Haas School of Business, University of California

Paul Zielinski; de Fontenay, Savin & Kiss

APPENDIX K

The New Zealand Herald
28 September 1995
(Section 3, page 5)

PHONE ACCORD DELAYED

Wellington: The formal signing of the Telecom and Clear local service inter-connection agreement is likely to be at the end of October rather than today as previously targeted.

The Clear chief executive, Mr Andrew Makin, said the September 28 completion date targeted when heads of agreement were announced early this month was overly-optimistic.

Mr Makin said the 1000-page contract being worked on by lawyers was a huge document which also embraced other matters, including the toll interconnection agreement which expires at the end of this year.

D

APPENDIX D